Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge Quarterly Update Report – October 2010

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Overview

This update is a summary of activities since the previous status report of July 2010 on the implementation of the Refuge's Enhanced Water Quality Monitoring and Modeling Program. A project overview, and other detailed information about the program can be found at: http://sofia.usgs.gov/lox_monitor_model/. The primary objective of this overall program (Brandt et al. 2004) focuses on providing information for use in ecological management of the Refuge (e.g., USFWS 2007a, b).

The Refuge's monitoring component of this program also addresses one of the Consent Decree Principals recommendations (17 December 2003):

> ***B. Enhancing Monitoring of the Refuge***
> *Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.*

The Refuge's modeling component of this program also addresses several of the Consent Decree Principals recommendations (17 December 2003):

> ***C. Modeling of the Refuge***
> *1. Develop a water quality/hydraulic model for the Refuge with a phosphorus cycling component.*
> *2. Evaluate issues associated with phosphorus loads and transports within the L-40 and L-7 canals.*
> *3. Develop and track a simple phosphorus mass-balance model for the Refuge.*

Information Availability

Through collaboration with USGS, information from the Refuge's Enhanced Water Quality Monitoring and Modeling Program has been made available on the USGS' SOFIA web site at: http://sofia.usgs.gov/lox_monitor_model/.

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at http://my.sfwmd.gov/dbhydroplsql/show_dbkey_info.main_page. Data for June 2006-June 2010 are posted on the Technical Oversight Committee's web site at https://my.sfwmd.gov/portal/page/portal/pg_grp_sfwmd_era/pg_sfwmd_era_techovercommittee. This report includes information from samples collected through September 2010.

Water Quality Data Analyses Update

Primary efforts for this quarter involved exploring mechanisms to continue translating information from the program to aid in Refuge management decisions, and working on the program's Annual Report.

Monitoring Update (July 2010 – September 2010)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 30 stations in July, 32 stations in August, and all 37 stations in September 2010 (**Table 1**).

Total phosphorus data available to date for October 2009 through September 2010 are presented in **Table 1**. Maps of stations where samples were collected for July 2010 through September 2010 are presented in **Figures 2-4**.

Conductivity sonde deployment information for October 2009 through September 2010 is presented in **Table 2**.

Modeling Update

During the third quarter of 2010, the Refuge modeling team continued efforts to finalize model versions. The UL modeling team, under the direction of Dr. Ehab Meselhe, now includes the full or part-time efforts of Dr. Chunfang Chen, Assistant Professor-Research, one doctoral student, and three graduate students seeking Master of Science degrees. We are moving forward on extending the calibration periods and improving calibration parameterization for the three compartmental models (SRSM, 9-Box, and 39-Box models), and the MIKE-FLOOD model. Under partial funding from the Corps of Engineers, the ADH model which is currently under development by the Corps of Engineers ERDC is also being investigated as our next generation model. The ADH model has several potential advantages over MIKE-FLOOD including being publicly available at minimal cost, anticipated wide use and acceptance by the Corps, feasibility of running on super computing platforms, and availability of source code for model adaptation to specific needs. Efforts continued on documentation of model development, use, and appropriate application. Continued develop of hydrologic performance measures was undertaken, and application of a high-water stage performance measure to address Refuge water needs was used to screen proposed alternatives.

Next Steps

The next steps for this program include additional efforts on the Annual Report, and additional model development and application.

References

Brandt, L.A., Harwell, M., Waldon, M. (2004) Work Plan: Water Quality Monitoring and Modeling for the A.R.M. Loxahatchee National Wildlife Refuge: 2004-2006. Prepared for the A.R.M. Loxahatchee National Wildlife Refuge. April, 2004. 33 pp.

USFWS. (2007a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Monitoring and Modeling Program – 2nd Annual Report – February 2007. LOXA06-008, U.S. Fish and Wildlife Service, Boynton Beach, FL. 183 pp.

USFWS. (2007b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 3rd Annual Report – October 2007. LOXA07-005, U.S. Fish and Wildlife Service, Boynton Beach, FL. 116 pp.

USFWS. (2009) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 4th Annual Report – July 2009. LOXA09-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 106 pp.

Table 1. Total phosphorus data (ppb) available for October 2009 – September 2010 from the Enhanced Water Quality Monitoring Program for: (a) marsh, and (b) canal stations for the A.R.M. Loxahatchee National Wildlife Refuge. Graphical representation of station locations are shown in Figure 1.

a) Marsh stations

Marsh Station	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10
LOXA101	10	8	9	10	7	13	9	-	14	-	32	22
LOXA102	6	7	-	5	4	4	-	-	-	-	-	16
LOXA103	12	9	8	7	12	-	-	-	-	-	-	20
LOXA105	16	13	11	11	10	U	8	-	20	19	24	26
LOXA106	15	8	7	5	U	U	5	-	11	15	14	15
LOXA107	5	-	-	4	U	-	-	-	-	-	-	19
LOXA108	4	-	6	7	8	10	U	-	6	7	-	9
LOXA109	U	8	4	7	6	U	4	10	11	9	10	11
LOXA110	U	5	11	8	5	4	7	10	10	10	10	7
LOXA111	U	6	U	5	U	U	3	8	5	6	8	7
LOXA112	U	6	5	6	5	U	U	6	11	17	11	10
LOXA113	U	4	17	5	U	U	U	6	U	5	8	5
LOXA114	U	4	U	4	U	U	U	7	6	8	6	5
LOXA117	5	11	9	12	5	4	5	10	14	28	17	33
LOXA118	4	10	4	5	4	U	2	10	10	10	11	11
LOXA119	6	8	5	5	U	U	4	8	8	9	9	7
LOXA120	U	6	27	3	U	U	3	6	7	7	7	4
LOXA122	5	9	9	6	5	U	6	15	19	18	17	21
LOXA124	10	9	13	7	9	19	9	9	18	16	13	18
LOXA126	U	11	8	6	5	14	3	12	14	18	18	20
LOXA127	U	8	5	4	U	U	U	7	-	18	12	9
LOXA128	U	4	-	9	U	U	2	5	U	6	7	4
LOXA130	9	17	12	6	7	3	3	11	13	14	8	26
LOXA131	U	14	7	8	6	U	U	8	8	13	12	11
LOXA133	25	56	19	26	28	14	14	-	30	-	17	46
LOXA134	3	24	10	8	8	19	5	9	11	13	11	21
LOXA136	15	-	13	13	8	17	7	22	18	-	-	33
LOXA137	6	15	9	9	9	5	6	12	9	8	8	18
LOXA138	U	6	9	9	4	U	U	7	10	7	8	9
LOXA139	6	6	-	3	7	U	4	11	6	9	6	7
LOXA140	11	10	9	9	5	U	10	9	11	-	10	18
LOXA141	8	15	8	14	10	U	10	15	10	12	13	13
MAX	25	56	27	26	28	19	14	22	30	28	32	46
MIN	3	4	4	3	4	3	2	5	5	5	6	4

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 1 cont.

b) Canal stations

Canal Station	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10
LOXA104	27	37	30	27	31	27	56	42	26	26	34	31
LOXA115	26	24	28	26	22	20	37	36	29	23	34	33
LOXA129	25	50	28	32	38	54	70	49	59	39	37	32
LOXA132	36	46	31	36	37	38	71	51	53	60	36	38
LOXA135	36	57	40	28	30	32	72	46	51	62	32	20
MAX	36	57	40	36	38	54	72	51	59	62	37	38
MIN	25	24	28	26	22	20	37	36	26	23	32	20

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 2. October 2009 – September 2010 conductivity sonde deployment information, separated by transect, for the A.R.M. Loxahatchee National Wildlife Refuge. X = data collected from sonde deployment during that month. Graphical representation of station locations are shown in Figure 1.

	2009			2010								
Site ID	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LOXA104	X	X	X	X	X	X	X	X	X	X	X	X
LOXA105		X		X		X		X	X	X		X
LOXA106		X		X		X		X	X	X		X
LOXA107		X		X		X		X	X	X		X
LOXA108		X		X		X		X	X	X		X
LOXA111	X		X		X		X		X		X	
LOXA112	X		X		X		X		X		X	
LOXA113	X		X		X		X		X		X	
LOXA114	X		X		X		X		X		X	
LOXA115	X	X	X	X	X	X		X	X	X	X	X
LOXA116	X		X			X		X	X	X		X
LOXA117	X		X			X		X	X	X		X
LOXA118	X		X					X	X	X		X
LOXA119	X		X			X		X	X	X		X
LOXA120	X		X			X		X	X	X		X
LOXA126	X		X		X		X		X		X	
LOXA127	X		X		X		X		X		X	
LOXA128	X		X		X		X		X		X	
LOXA129	X	X	X	X	X	X		X	X	X	X	X
LOXA130		X		X		X		X	X			X
LOXA131		X		X		X		X	X			X
LOXA132	X	X	X	X	X	X		X	X	X	X	X
LOXA133		X		X		X		X	X			X
LOXA135	X	X	X	X	X	X		X	X	X	X	X
LOXA136		X		X		X		X	X			X
LOXA137		X		X		X		X	X			X
LOXA138		X		X		X		X	X			X
LOXA139		X		X		X		X	X			X
LOXA142	X		X		X	X		X		X		X
LOXA143	X	X	X		X		X		X		X	
LOXA144	X	X	X		X		X		X		X	
LOXA145	X	X	X		X		X		X		X	
LOXA146	X	X	X		X		X		X		X	
LOXA147		X		X		X		X		X		
LOXA148	X	X	X		X		X		X		X	
LOXA149	X	X	X		X		X		X		X	
LOXA150	X	X	X		X		X		X		X	
LOXA151	X	X	X	X	X	X		X	X	X	X	X
LOXA152	X	X	X	X	X	X		X	X	X	X	X
LOXA153	X	X	X					X	X	X	X	X
I-8C	X		X	X			X		X	X	X	X
LOX04		X		X		X		X	X			X
LOX06	X		X		X		X		X		X	
LOX07	X		X		X		X		X		X	
LOX08	X		X		X		X		X		X	
LOX09	X		X		X		X		X		X	
LOX10	X		X		X		X		X		X	
LOX15	X		X		X		X		X		X	

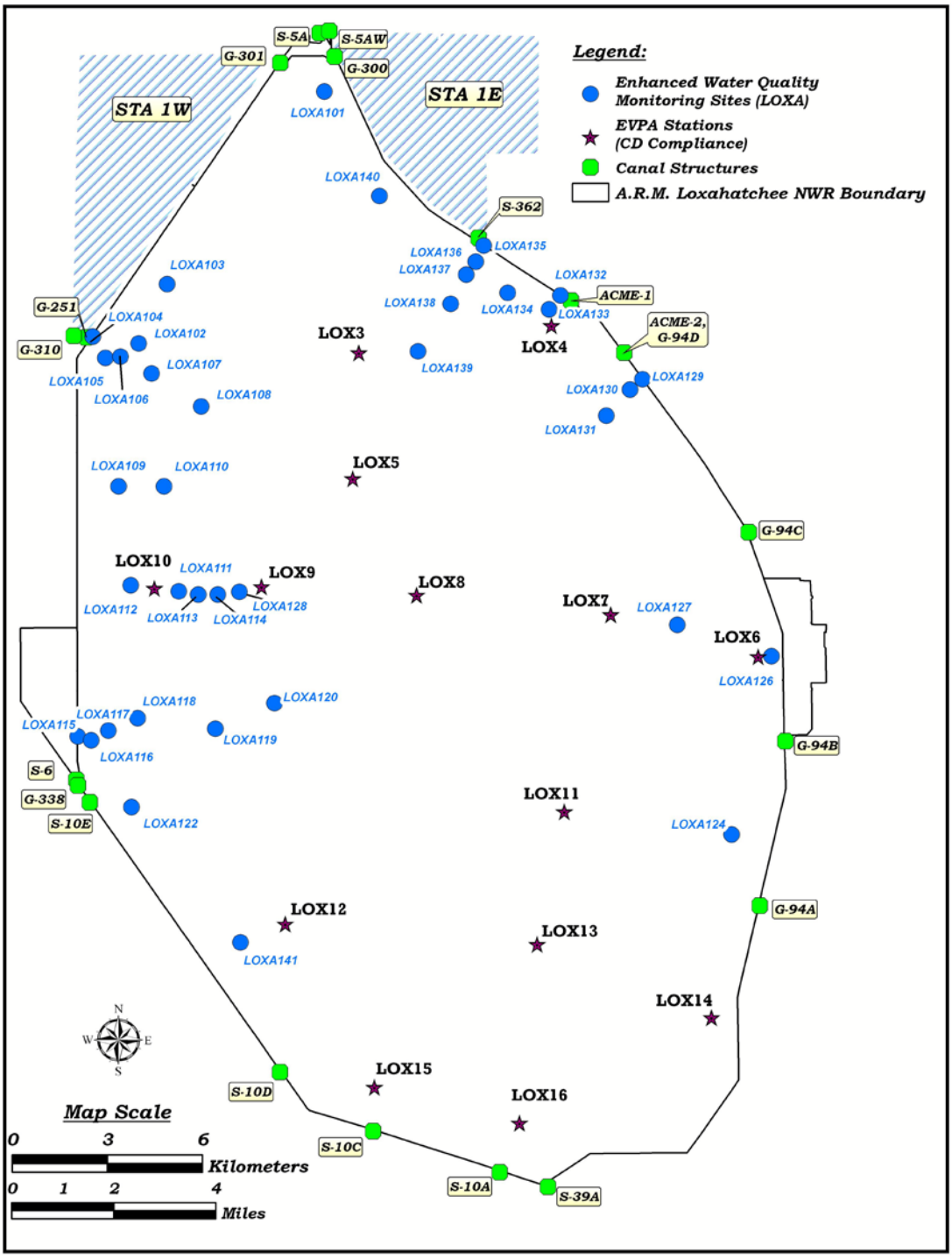

Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

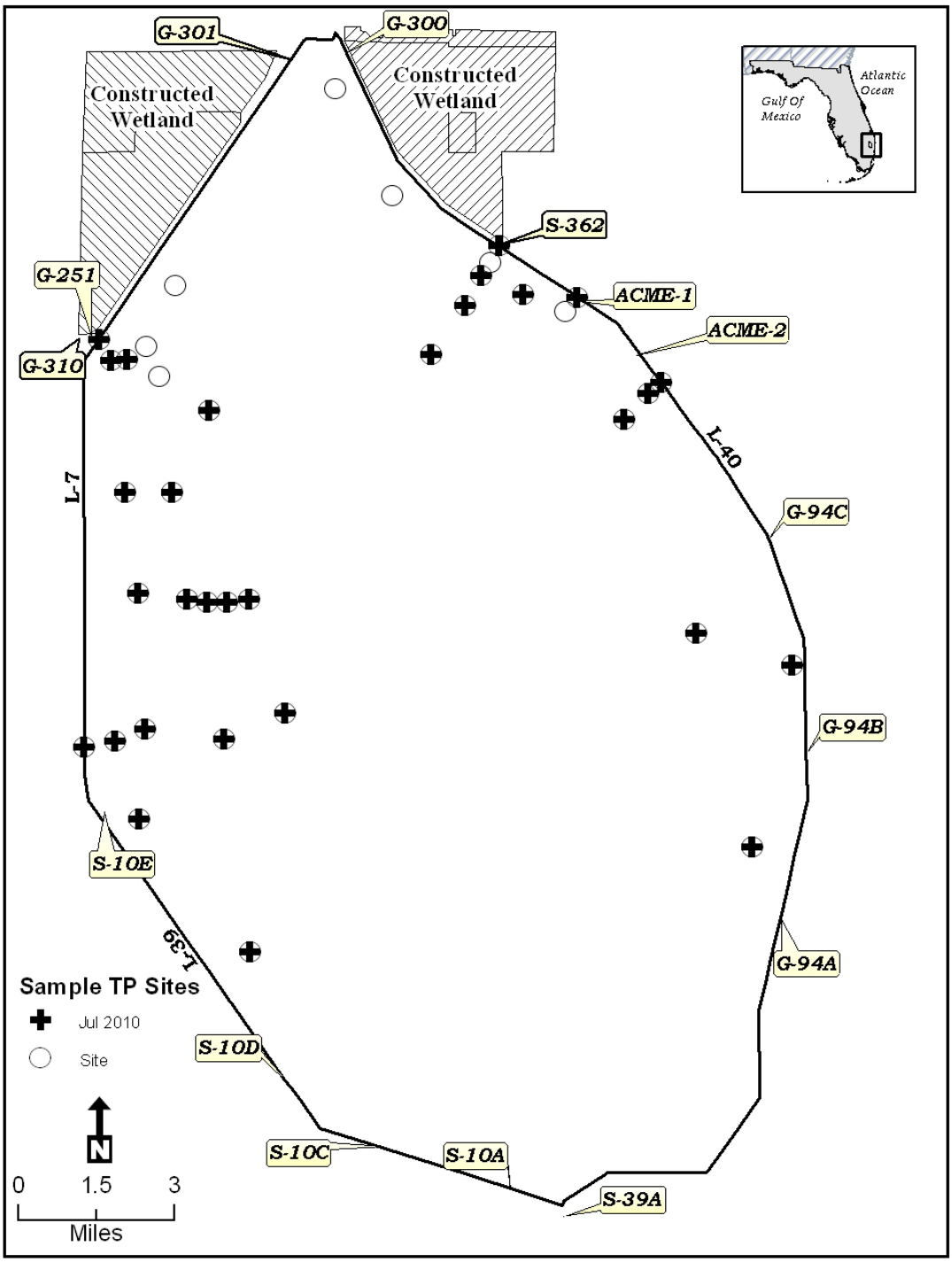

Figure 2. July 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

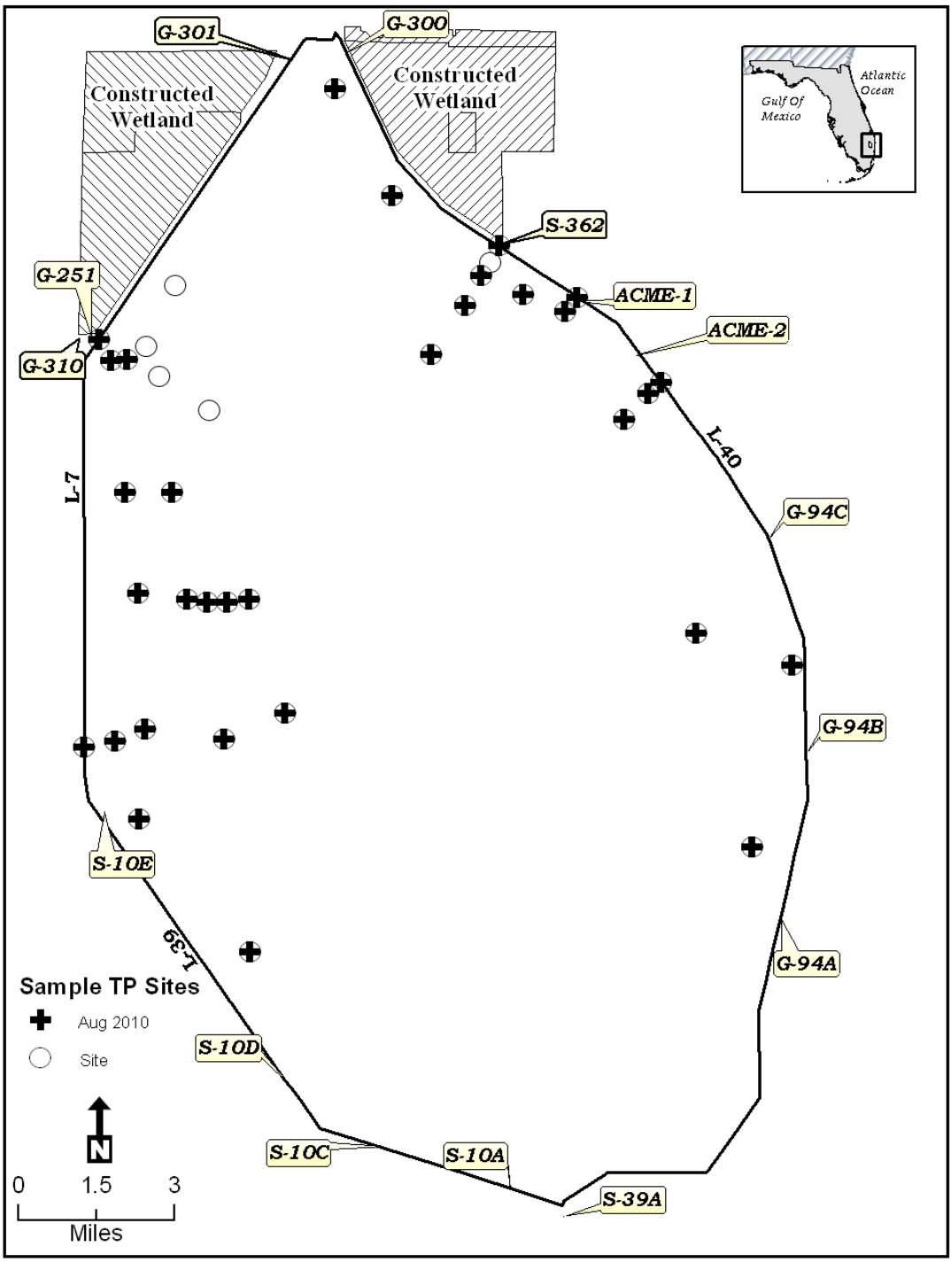

Figure 3. August 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

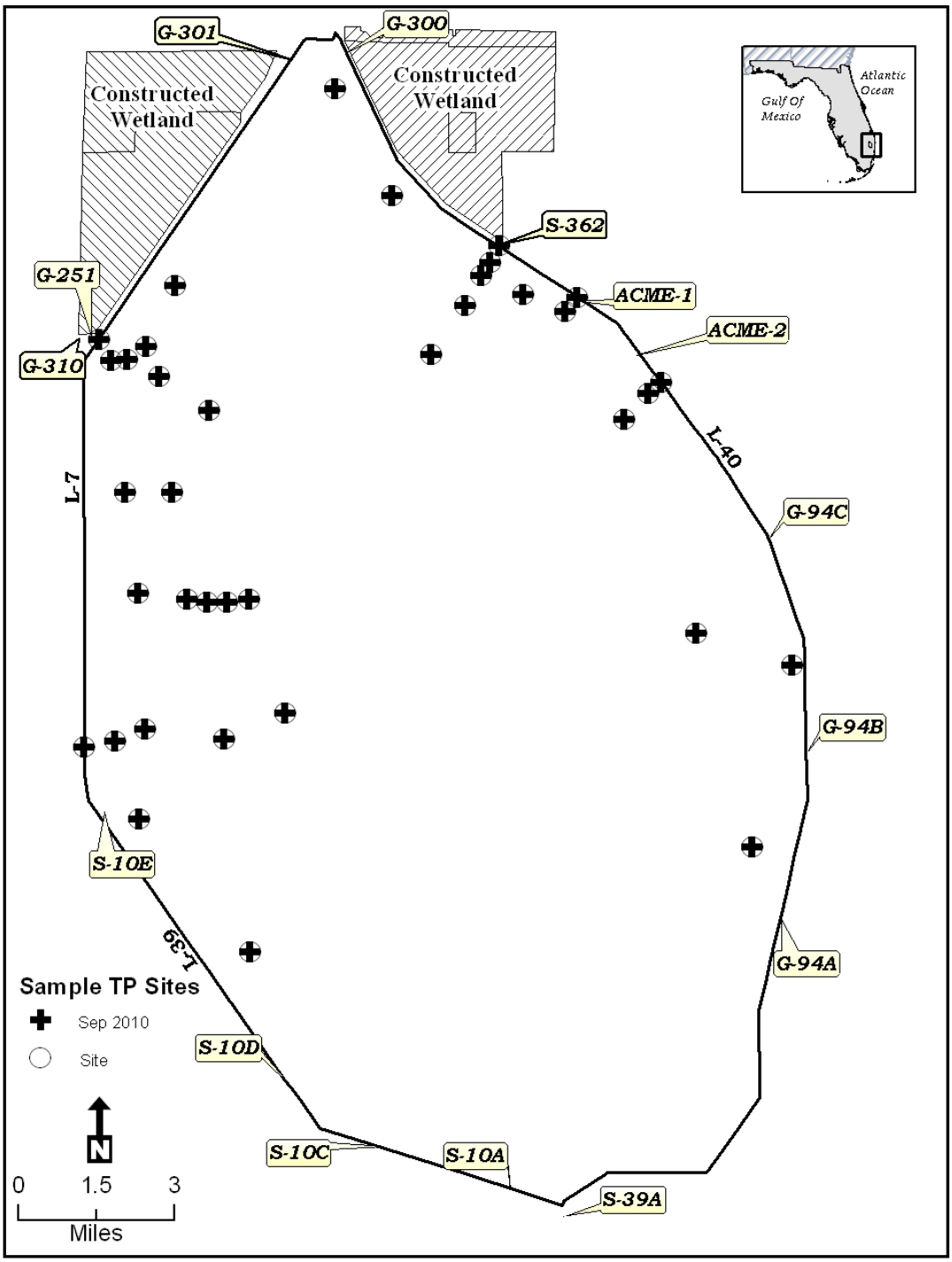

Figure 4. September 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.